Career and Technical Education
Promising Practices Initiative

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Division of Career and Technical Education,
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Featured Promising Practice:
Academic/Literacy Integration

Maine CTE Centers
working with this *Promising Practice*:
Bath Regional Vocational Center

Caribou Regional Technology Center

Presque Isle Regional Career and Technical Center

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Promising Practices descriptions and mini-case studies developed by
Julie Meltzer, Director of Literacy Research and Development for
Public Consulting Group's Center for Resource Management, Portsmouth, NH.

PUBLIC CONSULTING GROUP
CRM CENTER FOR RESOURCE MANAGEMENT
SOLUTIONS FOR EDUCATIONAL EXCELLENCE

PROMISING PRACTICE: *ACADEMIC/LITERACY INTEGRATION*

Description

Academic and CTE teachers collaborate to ensure that academic content is integrated into CTE program areas. CTE courses carry academic credit because they contain rigorous academic content and are aligned with the Maine Learning Results. Students are highly engaged because they are learning academic content within the context of their CTE program area.

Why Is This a *Promising Practice*?

Studies have shown that students understand and retain knowledge best when they have applied it in a practical, relevant setting (Daggett, 2005). According to Daggett (2005), at the high school level, career and technical education programs provide the most effective learning opportunities. "Not only are students applying skills and knowledge to real-world situations in their CTE programs, but also they are drawing on knowledge learned in their core subjects. Students who participate in CTE programs should be well prepared for state exams because the academics they learn are used in Quadrants B and D. The key is to tie those academics to core content areas. In this respect, CTE teachers can be a great help to language arts, math, and science teachers by reinforcing the skills and concepts that students learn in those subjects."[1]

According to Roberson, Flowers, and Moore (2001), vocational and academic integration has been supported by the teaching profession and business and industry. "The concept of vocational and academic integration has been endorsed by the U.S. Office of Education since the mid-1930s (Moss, 1990). Gable and Ransdell (1993) stated that the concept of vocational and academic integration is supported by educators, business and industry, and government policy makers. Pritz and Davis (1990) emphasized the equal importance of both academic and vocational skills. They identified both types of skills as being essential in the workplace so workers would be flexible enough to solve problems and keep up with new technology. Capelli (1990) also stated that both academic and vocational skills were important for students' success in the job market. According to Tremaine (1992), vocational and academic curriculum must integrate in order to meet students educational needs and make education more meaningful and relevant."[2]

Taylor (2001) summarizes others' conclusions: "Beane (1998) suggested that the importance for curriculum integration is evident through the growing support for active learning and construction of knowledge, through the interest in patterns of the brain process as they relate to learning, and through current research supporting constructivism. According to Brown (1998), learning in context and the construction of knowledge through prior experiences are two concepts that relate to integrating academics, career, and technical education."[3]

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[1] Daggett, W. R. (2005). Achieving Academic Excellence through Rigor and Relevance. Paper published on the International Center for Leadership in Education website. Accessed July 26, 2006 at http://www.daggett.com/pdf/Academic_Excellence.pdf

[2] Roberson, D. R., Flowers, J. L., & Moore, G. E. (2001). The Status of Integration of Academic and Agricultural Education in North Carolina. *Journal of Career and Technical Education, 17*(1). Accessed July 26, 2006 at http://scholar.lib.vt.edu/ejournals/JCTE/v17n1/roberson.html

[3] Taylor, C. B. (2001). Teachers' and principals' perceptions of precursors to integrating academic and career and technical education. Virginia Polytechnic Institute and State University. Unpublished doctoral dissertation. Accessed July 26, 2006 at http://scholar.lib.vt.edu/theses/available/etd-06122001-110038/unrestricted/ Dissertation VERSION2.PDF

Taylor (2001) characterizes three primary formats for academic integration into CTE classes or programs: 1) academic and career/technical education instructors team teach classes, 2) day-to-day instruction incorporates academic and career and technical skills, and 3) class projects are jointly sponsored by academic and career and technical education teachers.[4]

Taylor (2001) also outlines four types of strategies that support academic integration:

- Instructional strategies
- Curricular strategies
- Collaborative strategies
- Administrative practices and procedures[5]

What Does It Look Like in Maine?

In Maine, three CTE centers are working to promote academic/literacy integration into specific CTE programs. The three mini-case studies that follow describe how the centers are working with the strategies that Taylor (2001) outlines in the summary above. Two of the centers began their focus on academic integration in the past year while one of the programs is in its fourth year of implementation. Next steps are listed for each.

[4] Taylor, C. B. (2001). Teachers' and principals' perceptions of precursors to integrating academic and career and technical education. Virginia Polytechnic Institute and State University. Unpublished doctoral dissertation. Accessed July 26, 2006 at http://scholar.lib.vt.edu/theses/available/etd-06122001-110038/unrestricted/DissertationVERSION2.PDF

[5] ibid.

Promising Practice in Action: *Academic/Literacy Integration*

Bath Regional Vocational Center (BRVC)[6]
Bath, ME
Jon White, former Director (recently retired)
Merton Dearnley, Director

- **Location:** Integrated locations on both sides of Morse High School.
- **Student population:** 220 (others take some classes but are not enrolled in CTE programs)
- **Sending schools/districts:** 4

  - **Program focus:** Partnership with Morse High School to integrate science into four CTE program areas—health/sciences, auto technology, computer-assisted design (CAD), and building construction. Students receive one half-credit science elective each year and can fulfill the 3rd year of the science requirement in two years.

Jon White, the former director, said he was a little hesitant to apply to be a *promising practices* site because the project at BRVC was just getting underway. But he was excited about what was happening and wanted to "get it out there." He thought it was impressive that one of Morse science department's listed accomplishments for the year was a focus on academic integration into CTE classes. He thought that the enthusiasm of the CTE teachers was worth noting.

Getting Started

Two years ago, some BRVC teachers attended Alan Dearborn's session at the Maine Association Vocational Education Administrators (MAVEA) conference and got inspired. Soon after, there was a Wednesday morning curriculum meeting and CTE instructors were told to join one of the academic departments. The science department welcomed the CTE teachers and the conversation began. CTE teachers from different program areas (auto technology, building construction, health occupations, drafting technology, and computer technology) met with members of the Morse science department and compared notes on what they were each doing in their courses.

What It Looks Like in Action

During the 2005–06 school year, several curriculum-related events took place that involved collaboration between the science department and the CTE teachers. All freshmen explored the science of airbags; academic students learned how to do CAD representations of molecules and catapults; and automotive classes worked with the physics of hydraulic lifts. The CTE health sciences instructor and the teachers of biology and health classes at Morse High School also collaborated on some lessons. In addition, the science department and BRVC co-wrote and received a GIS grant for $40,000 worth of mapping software. Science credits were negotiated for selected BRVC courses.

The teachers know the program needs to evolve—and they want it to. Two teachers would like to co-teach the pre-engineering class. The auto technology teacher said he would like to go to a physics or chemistry class and "see how they teach 'specific gravity' and come up with a lab. And then my kids could go to class and their kids could come to my lab." The building trades teacher has been discussing an interdisciplinary project for next year: designing a super-

[6] This mini-case study is based on conversations with BRVC and Morse High School staff, review of documents, and data collected during an onsite visit in May 2006.

insulated house. According to the teachers on both sides, willingness to collaborate was not an issue, but finding meeting and planning time was a challenge.

CTE and science department teachers indicated they would like to define what types of science experiences should take place each year with each class, and how these experiences would help students address the Maine Learning Results. They would like to make sure events that do occur are as rich as possible for all of the students. For example, in automotive technology earlier this year, freshmen science classes imploded air bags, took a variety of measurements, and made deductions about chemical reactions. “The lesson was good,” said the science teacher, “but we should have had the CTE classes learning more of the science instead of just setting up the lab.” The CTE teacher agreed: “We wired up the airbags but we didn’t work on the academic side; and they didn’t do the set-up. We have to figure out ways to have more impact for both groups of kids.”

Lastly, CTE teachers indicated they want to make sure that, where applicable, students will get the credit they deserve for the integrated academic content they learned in their CTE classes. The group of BRVC teachers involved with this project recognized that preparing students for the 21st century workplace means integrating rigorous academic content and literacy skill development into CTE program offerings. If they commit to making sure this occurs, they want students to receive academic credit and not have to repeat the same content in another setting. “There is too much to learn to be duplicating efforts. It shouldn’t matter which side they learn it on—they should get the same credit if it is the same content.”

Sustaining the Work

Institutionalizing the work will require four steps (as outlined by the BRVC Advisory Board and Student Services Advisory Council):

- Integrate core benchmarks within BRVC programs.
- Establish a timeline to address further integration implementation.
- Propose a method of updating processes as needed.
- Evaluate process in order to promote relevance and rigor.

At issue is the right of students to access quality learning in CTE settings that will adequately prepare them for the 21st century workplace. BRVC educators have worked on this—but recognize there is a lot of work left to do.

Reciprocal Teaching

While talking to the science and CTE teachers, there was a clear respect for one another’s knowledge and work. It was not about science teachers teaching in CTE classes, but, instead, bringing the classes together and co-teaching the concepts from two perspectives. Some science teachers brought their academic classes to the “labs” (shops) on the CTE side to learn. “Well, really, it’s to play with all of the cool stuff!” laughed one science teacher. Relationships developed between CTE and academic teachers. Both the former CTE director and the high school principal talked about a vision where the divide between the two continues to diminish and rigorous motivating contexts for learning are found as the norm on both sides. The high school principal said she is very excited about the partnership and hopes it expands to other departments.

Teachers on both sides noticed what has happened thus far. Meetings were planned with the English and math departments and CTE teachers to explore opportunities for similar types of academic integration with those departments and specific CTE program areas.

Students noticed, too. Many more showed interest in CTE classes since the academic classes began "going over to the other side." One student mentioned she plans to take the CAD class next year because of her experience with doing the molecular modeling in chemistry class this year. She said she did not even know there were classes like that offered at the high school level. In fact, enrollment in the next year's CAD classes was up 250% according to the science department chair who attributed this to greater exposure through the science classes and the opportunity to earn science credit by taking selected BRVC courses.

Improving Literacy Development

Two of the teachers at BRVC participated in the CTE Literacy Mentor Project, tried out and adapted literacy support strategies in their classrooms, and were responsible for presenting content-area literacy workshops to their colleagues at school. One of the mentors mentioned the importance of modeling for students how they read and how they use vocabulary because "they might not have those models at home." He talked about how using the strategies has made a difference in how students make connections in really simple things like teaching the vocabulary before he assigns the reading: "It makes a big difference!" In the other mentor's classroom, students read using a graphic organizer with an article about a war veteran who is an amputee and has to get a car with an automatic rather than a manual transmission. A variety of trade magazine covers and articles were posted on the bulletin board. The former CTE director indicated that he wants the CTE center to be a resource for the sending high schools so they can see how literacy development can and should be integrated into all content areas: "It's so important, it's really critical."

In the health sciences classroom, the teacher explained, "It's all about the fact that you have reading material in your professional trade or technical area, stuff that you need to know." She mentioned that the CTE context is a good place to work on literacy because of the relationships teachers have with students and the interest students have in the content. The teacher described the clinical review papers students were asked to do using a specific format each Monday to reflect on what was learned at their clinical placement. If students missed a day at their placement, they were asked to read and respond to a relevant article. Periodically, the whole class was assigned an article to review and evaluate in light of what they know. A specific template was provided to ensure that students responded to the reading thoughtfully. The health sciences classroom was filled with student-made and commercial posters. Students were quizzed one another on vocabulary terms; there was a medical terminology jeopardy board on the wall.

Next Steps

- Define what types of science learning will be expected to occur in each CTE class and what types of activities will help students develop that understanding.
- Establish ways to measure whether students are learning the science concepts that are being integrated into their program area.
- Develop similar avenues and supporting credit systems to allow English and math integration to also take place and be valued as part of BRVC program offerings.
- Ensure that literacy-rich environments, with trade magazines and knowledge and application of literacy support strategies, to develop reading, writing, speaking/presenting, and critical thinking skills are occurring regularly in all CTE programs.
- Review program expectations to ensure they are uniformly high and publish the relevant literacy habits and skills students will work on in each CTE program area.
- Resolve articulation and credit agreements with all sending schools.
- Select a reading assessment or ask all sending schools for data on students' reading levels.

- Discuss collaboratively how sending schools could better prepare students for upper level work at the CTE center or at their home high schools.

For more information, contact Bruce Scally, Student Services Coordinator; Peter Gagnon, Cindy Harris, or Dean Emmerson, BRVC teachers.

Promising Practice in Action: *Academic/Literacy Integration*

Caribou Regional Technology Center[7]
Caribou, ME
Lynn R. McNeal, Director

- **Location:** Independent building adjoining Caribou High School
- **Student population:** 360
- **Sending schools/districts:** 6

  - **Program focus:** Partnership with Caribou High School to integrate science into six CTE Program Areas—industrial construction, large equipment maintenance and operations, commercial driving licensure, automotive repair, auto-body (collision), and welding. Students get one science credit for chemistry upon completion of each two-year program, thus fulfilling the requirement.

Getting Started

Alan Dearborn began as a science teacher "on loan" to the Caribou Regional Technology Center during the 2002–03 school year. The Caribou High School science department quickly recognized the need for a third year of science to ensure all students met the Maine Learning Results, but also recognized that it would be impossible for CTE students to fit in their schedules. Academic achievement was a concern, but so was student access to CTE programs. A plan, supported by the high school principal, Dave Ouellete, and the CTE director, Lynn McNeal, was devised to integrate academic science content into CTE program area classrooms. Dearborn would be relieved from teaching high school courses for two periods a day to go and work with CTE teachers and teach science content that related to the CTE program area. The assessments for high school students and CTE students were the same Level II assessments.

CTE teachers responded positively—they did not see this as a loss but as a way to enrich their programs through relevant science content. Science was integrated into six two-year CTE program areas: industrial construction, large equipment maintenance and operations, commercial driving licensure, automotive repair, auto-body (collision), and welding. By participating in those programs for two years and by having Dearborn provide science-related instruction for one period per week, one year of students' three-year science requirement was waived. Four years into the process, Dearborn is still working on new lessons to add to the 87 lessons already developed. A sequence of lessons is keyed to teach and/or reinforce physical science concepts. Dearborn tracks the lessons that were taught in each class each year to document the chemistry concepts that were addressed. Several lessons are the same content-wise across programs but the application piece differs. For example, demonstrating an understanding of energy in chemical bonds might be explained through a study of adhesion/cohesion/bonding and glues and/or through an examination of the combustion of vapor. All lessons developed to date are plotted on a lessons/standards grid so the content of the academic integration can be easily checked.

What It Looks Like in Action

Science lessons began with high interest activities that give Dearborn immediate credibility with the students. He then connected the activity to the science behind it and worked with the

[7] This mini-case study is based on conversations with CTE and high school staff, CTE students, review of documents, and data collected during an onsite visit in June 2006.

students to apply the concepts directly to what they were working on in the shop. For example, he exploded dust with the auto-body class and did vapor explosions, discussing why bonds harden and paint dries. Dearborn planned the curriculum so he can "hit the same topic in different ways over the course of the year." In the large engine class, for example, he worked with air–fuel ratios during several sessions in a variety of different ways. Dearborn had the same planning period as the CTE teachers—8th period—so he could meet with the instructor, review upcoming terminology, discuss what was happening in the shop, and plan to connect the lesson as much as possible to the "lab situation" the shop provided.

Keys to Success

The director and the CTE teachers agreed that Dearborn has great rapport with the five instructors, possesses a lot of knowledge, relates with the students, works well with the teachers, and is very flexible. Informal interviews with some of the CTE instructors generated the following comments:

> *Electricity, that was a good one. I think this year we really did it well—we actually wired up the playhouse and talked about current and electricity. It makes sense when it is relevant*.
>
> *He's a real hands-on kind of guy—that's what it takes to make it happen. He takes the science and does a real good job of relating the science end of it. The kids end up using a lot of the terminology.*
>
> *I think he is very well received—you know, he is like Bill Nye the Science Guy—he makes it real and he definitely keeps their attention. If I had had the science when I was in the program, a lot of the stuff I found out over time would have been learned right here—stuff I had to learn by reading the trade magazines. I think this gives students a concrete base to work from.*

What Students Said

Students seemed to agree. One auto-body student said that the science "relates a lot of the time" to the trade area. That same student gave an example: "He's teaching us a lot about bases and acids and I learned that overcharged batteries can explode. We have to know that kind of electrical stuff when we are working on interiors so that's helpful."

> *I like it much more than [another science class] I had to take. He talks about things that relate like pigment and paint. One time he had four vials—town water, a base, an acid, and salt water—and asked us to predict which would take the fastest to rust a piece of metal. It was the town water—acid rain eats up the metal—within a week it rusted all the way through. I couldn't believe it.*
>
> *I liked the lesson on the electrical stuff. We took wires and three lights and did serial hookups and saw different ways to hook them up. So that was good—we could learn what to do with the electrical under the dash after a crash—it really relates to what we do.*

Use of Data

The CTE center uses CTBS and TerraNova test data to determine where students are in terms of academic skills. All students are expected to score at least 85% on the basic competency test. Tutoring services are provided in response to students' needs.

Other Academic and Literacy Supports in Place
All students at Caribou High School read and journal for 45 minutes during their English period on Thursdays—something that the CTE director said has made a positive impact on the school's culture. According to McNeal, there is "a culture of high expectations in place." There has been a collaborative staff development team made up of high school and CTE teachers and administrators dating back to the mid-1980s.

Evidence of Student Learning
Hard evidence of student learning is more difficult with the assessment program on "pause." Initially, Dearborn developed and tested Level II assessments with academic and vocational students. For example, on an assessment for acids and bases, Dearborn indicated 80% of the CTE students met the standard. "But the instruction was different—over here, I could tie it to auto-body, etc." He noted that 85–90% of the CTE students were able to build a 3D model of characteristics of the periodic table and answer questions about it. The third assessment on conservation of matter also had a high student success rate. There was a shared sense among administration, teachers, and students that learning science this way is a good approach. Some students asked to take their science through the CTE center instead of taking another academic science class.

Next Steps
- Develop a way to track evidence of learning of science concepts and of success given that the assessment system is currently paused. Add science items to CTE tests in the six program areas.
- Keep developing lessons that are increasingly keyed to what CTE instructors need.
- Work on articulation of science concepts addressed during the junior versus the senior year.
- Think about how to increase the literacy development piece of the science lessons—this would help improve learning and assessment. Use of quick writes, coding when reading, note taking graphic organizers, vocabulary strategies, and anticipation/reaction guides may fit well.
- Work on sending school reciprocity, agreements, and credits.
- Make sure all CTE program areas have at least two different trade journals; enough for a class set. Use these to reinforce or augment the science lessons.

For more information, contact Lynn McNeal, Director, or Alan Dearborn, Caribou High School Science Teacher.

Promising Practice in Action: *Academic/Literacy Integration*

Presque Isle Regional Career and Technical Center (PIRTC)[8]
Presque Isle, ME
Melissa Vance, former Director (recently retired)
Larry Fox, Director

- **Location:** Adjacent to Presque Isle High School
- **Student population:** 285 (almost all are from Presque Isle High School)
- **Sending schools/districts:** 7

    - **Program focus:** Integration of literacy and academic rigor into the Agri-Science program.

There has been an agricultural science program at PIRTC since 1991 but the academic side of it has not been emphasized. However, the district's Educational Farm and related businesses (nursery, cidery, orchards, farm stand, wholesale fruit) have received much attention. In response to enrollment trends and discussions about academic requirements resulting from the Maine Learning Results, it was decided that the academic side of the program needed to be substantively revised.

Getting Started
Under the direction of the former CTE director, a new program lead teacher was hired in the summer of 2005 and her first task was to redesign the core science courses into a two-year *Applied Science* course sequence that would:

- Meet all four life science content standards of the Maine Learning Results
- Add needed academic rigor to the curriculum
- Integrate literacy development into the program

Students who take the two-year sequence of *Applied Science* courses are assessed using the same assessments as Preque Isle High School biology students and receive a Life Science credit. In addition, they get substantive hands-on experience through real-life agricultural experience in the laboratory, greenhouse, or school farm. Additional courses in the program include agricultural application courses (aquaculture, agricultural production, and natural resources conservation). Leadership and work experience classes complete the curriculum.

The 2005–06 academic year was the first year the new curriculum was implemented.

Literacy Integration
Literacy development was integrated into the *Applied Science* classes in several ways during the 2005–06 school year. The classroom environment where instruction took place was literacy-rich. In the two connected rooms, the shelves were full of textbooks, trade journals, and reference books. On the walls there were posters, pictures of the farm and the science fair, and signs. One room had a bank of computers. A "quote of the day" was displayed on a flip chart. Magnetic poetry was on the white board. A lab safety word/phrase wall was in the back corner of one room. An events calendar and newspaper clippings were on a side wall. One of the instructors remarked, "I don't understand how you can teach anything without teaching literacy."

[8] This mini-case study is based on conversations with PIRTC staff, document and student work review, and data collected during an onsite visit in June, 2006.

Approaches to literacy integration included:

- *A focus on vocabulary*. Students received assigned vocabulary at the beginning of the chapter. Students also obtained a comprehensive list of scientific suffixes and prefixes with meanings and examples which they added to throughout the year.
- *Web-based Scavenger Hunts.* Students were asked to complete several web-based scavenger hunts that required skimming, reading for information, analyzing, and synthesizing. Topics for 2005–06 included *herbs, biotechnology,* and *the human genome project*.
- *Note taking*
- *Reading aloud*
- *Use of leveled lab manuals.* The lab manuals that accompanied the biology textbook used in the course came in two ability levels and helped the instructor address the high percentage of identified students in *Applied Science I* (50%) and *Applied Science II* (10%). The textbook was a standard biology text published by Prentice Hall.
- *Additional reading beyond the text.* Reading and responding to trade journals, Internet articles, and readings in other texts was expected during the year.
- *The Science Fair Project*

All *Applied Science* students participated in an Agri-Science Fair Project, held for the first time during the 2005–06 academic year. This new program component, described in the Program of Studies, required students to investigate an issue in agricultural science and design an experiment using the scientific method. Students completed written papers documenting their methods, findings, and conclusions, and each created a display of results on posterboard trifolds. Projects were judged "according to how well the students followed the scientific method and were able to display and explain their months of work" (Program of Studies, 2006–07). What was unique about this long-term assignment was the scaffolding provided—even students with weaker reading, organizational, and writing skills were able to be successful. Students received feedback on each component all along the way. Clear guidelines with eleven steps described what students were to do between mid-October and the fair in mid-March. State and national FFA science fair standards were incorporated into the project criteria. The expectations were high and the teacher reflected that many students needed to recreate several pieces more than once.

Projects were completed in the scientific areas of botany, zoology, micro-biology, engineering, natural resources, biology, and agriculture and included exploration of such topics as deer feeding, cooking sprays, potato storage, and plant fertilizer effects. While it was clear some of the students had more difficulty with expressing themselves in writing, and some experiments were much simpler than others, an examination of posters, pictures documenting the process and the fair, and discussions with the instructors made it evident this project had supported students to develop general academic literacy skills—*reading, writing, presentation,* and *critical thinking skills*—as well as to develop scientific literacy skills—*an improved understanding of the scientific method, scientific texts,* and *formats*.

Improved Academic Rigor

In several ways, the *Applied Science* classes were more academically rigorous than the Agri-Science classes they replaced. First, an *applied science* textbook was used instead of the earlier agriculture textbook. The course design was more rigorous because of the need to address the life science standards and included more hands-on scientific applications as part of the curriculum. The increased assessment requirements, note taking requirements, science fair requirements, and general reading and writing requirements also added rigor to the course

expectations. In addition, the class periods at the farm were limited and those that occurred included *applied science* lessons as well as work experience.

Next Steps

- Establish a career portfolio requirement for Agri-Science students.
- Ensure that all Agri-Science students complete at least two science fair projects.
- Incorporate more literacy development strategies into instruction, such as the use of triple-entry vocabulary journals; notetaking strategies other than copying of notes; paired or rehearsed reading; and use of editing checklists.
- Discuss the appropriate population for the program, course articulation, and credits with sending schools.
- Review other CTE program areas to determine if they might benefit from greater academic and/or literacy integration.

For more information, contact Larry Fox, Director, or Shelly Gross, Agri-Science Program Leader.